

SYNERGY WITH A POSSIBLE UNDERGROUND LABORATORY IN THE SOUTHERN HEMISPHERE FOR DARK MATTER SEARCH

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DAMA-LIBRA SIGNAL

Unique array of 250 kg high purity NaI

Including also the first generation DAMA/NaI experiment (cumulative exposure $1.33 \text{ ton} \times \text{yr}$, corresponding to 14 annual cycles): 9.3σ significance for an annual modulation compatible with DM expectations

No other NaI experiment has been able to observe the annual modulation so far

No explanation of the modulation due to effects from known particles (neutrons, muons, neutrinos)

see <http://arxiv.org/abs/1409.3516v1>

When interpreted in the WIMP framework (model dependent), tension with other results from experiments using different targets (XENON, LUX, CDMS, etc...)

Confirmation of DAMA LIBRA results still missing.

A WAY FORWARD

New NaI(Tl) target experiment following DAMA LIBRA concept + background control (active veto)

To be installed at the same time at LNGS and in a different underground site

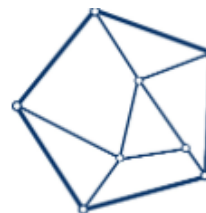
In the southern hemisphere seasonal modulations have opposite phase: an effective way to disentangle this kind of background

Contact with University of Melbourne lead to the identification of a possible underground site: **Stawell Gold Mine in Victoria (Australia)**

Sunday 28 September to Tuesday 30 September 2014 - Joint CoEPP-CAASTRO workshop + INFN representatives (both management and researchers) with visit to the underground mine



CoEPP
ARC Centre of Excellence for
Particle Physics at the Terascale



CAASTRO
ARC CENTRE OF EXCELLENCE
FOR ALL-SKY ASTROPHYSICS

STAWELL GOLD MINE IN VICTORIA

credits Matteo Volpi and COEPP group University of Melbourne



1600m maximum depth. Caverns at many different depths (including one interesting site at 1025m depth). Many caverns have concrete sprayed surfaces. Decline mine: accessible via cars/trucks. The access road supports mining vehicle traffic.

The mine is “dry”, has power, compressed air and fibres.

Surrounding rock is basalt: density 2.86 t/m^3

MEASUREMENTS

Preliminary measurements were performed in 2 different locations: workshop (729 m deep) and cavern (880m deep)

	LNGS	STAWELL MINE
Overburden [m w.e.]	~ 3600	~3000
Muon flux [$\mu/\text{cm}^2/\text{s}$]	~ 3×10^{-8}	Setup of measuring station ongoing
Neutron flux [$\text{n}/\text{cm}^2/\text{s}$]	~ 4×10^{-6}	BF ₃ tubes for counting slow and fast neutrons. First preliminary results: slow n flux = $6.92 \times 10^{-6} \pm 2.7\%$ (stat) +5% (eff) fast n flux = $2.02 \times 10^{-6} \pm 6\%$ (stat) +5% (eff)
Gamma flux [$\gamma/\text{cm}^2/\text{s}$]	~0.73	Preliminary measurements with a portable NaI crystal: ~1 (0 to 3 MeV)
Radon [Bq/m^3]	~ 50	~36 (using compressed air system)

All measurements to be repeated at 1025 m. Collected rock samples for screening.

THE DETECTOR

Crucial point is the radio purity of NaI(Tl) crystals and background control

SABRE (Sodium Iodine with Active Background REjection) proposed at LNGS scientific committee addresses both points:

<https://agenda.infn.it/getFile.py/access?contribId=6&resId=0&materialId=slides&confId=7861>

SABRE test on prototype crystals at LNGS in the near future

R&D at SICCAS for the production of high purity NaI powder

Italian groups interested so far: MI, LNGS, NA , RM1

Australian universities already interested in the project: Melbourne, Adelaide

International collaboration to be built

